ISSN 2250-3153

The Efficacy of Computer Assisted Cognitive Training in the Remediation of Specific Learning Disorders

Nisha, V[*], Kumar, K. B[**]

[*] Research Scholar, Department of Psychology, Christ University
[**] Dean; Professor and Head, Psychology, Sweekar Academy

Abstract- Neuropsychological deficits have been found to underlie the developmental disorders of various skills. Studies conducted thus far suggest education based remedial training (EBRT) to be beneficial in overcoming the developmental skill deficits. Though, computer assisted cognitive training (CACT) has been found to be effective in enhancing various cognitive functions in cases of traumatic brain injury, stroke, schizophrenia, the effect of this intervention strategy has not been explored in helping children with specific learning disorders (SLD).The aim of the present study therefore was to examine the effectiveness of CACT when employed as an adjunct with EBRT in the management of children with Reading, Spelling and Arithmetic disorder. 10 children between the ages 8 and 15 years meeting at least one of the ICD-10 criteria for Reading, Spelling and Arithmetic disorder were sequentially assigned to either EBRT + CACT, or only EBRT. The training for both the groups was conducted in 8-12 sessions, spread over 2 months. Pre- and Post-assessment was conducted using NIMHANS SLD index. It was found that the adjunct intervention relative to EBRT was superior in augmenting various academic skills. However, these differences did not reach statistically significant level owing to smaller sample size. The use of CACT along with EBRT resulted in significant improvement in Spelling ability of the group undergoing the same. The CACT seems to have therapeutic potential in developmental disorders when combined with EBRT.

Index Terms- Computer assisted cognitive training, Education based remedial training, Neuropsychological deficits, Specific Learning Disorder

I. INTRODUCTION

Specific learning disabilities (SLD) is a generic term that refers to a heterogeneous group of neurobehavioral disorders manifested by significant unexpected, specific and persistent difficulties in the acquisition and use of efficient reading (dyslexia), writing (dysgraphia) or mathematical (dyscalculia) abilities despite conventional instruction, intact senses, average intelligence, adequate motivation and socio-cultural opportunity (Shapiro and Gallico 1993).

SLD are intrinsic to the individual, presumed to be due to central nervous system dysfunction, and are chronic life-long conditions. Children with SLD fail to achieve school grades at a level that is commensurate with their intelligence. The incidence of dyslexia has been reported to be 2-18%, of dysgraphia 14%, and of dyscalculia 5.5% in primary school children in India (Mittal et al 1977; Shah et al 1981; and Ramaa et al 2002). The cornerstone of treatment of SLD is remedial education, in which the child has to undergo sessions twice or thrice weekly for a few years to achieve academic competence.

The existing literature suggests that children with SLD have neuropsychological deficits especially in attention (Richards et al 1990); working memory (Swanson and Siegal 2001); phonological processing (Wilson and Lesaux 2001); perceptual skills (Harris 1995) and visuo-spatial ability (Facoetti et al 2001). Interventions targeting these deficits are very few, particularly those employing computer based cognitive remedial training.

Though this kind of training has been used in cases of Traumatic Brain Injury, Schizophrenia, Alcohol Dependence Syndrome to remediate the cognitive deficits, the efficacy of such computer based packages have not been studied with respect to specific learning disabilities except for one study by Solan et al (2003). This study examined the effectiveness of computer based visual attention therapy in remediating the reading comprehension in a group of children with moderate reading disabilities and found it to be beneficial in improving the reading skills. Research on cognitive neuroscience using computer technology has shown some promise in improving cognitive functions. A recent research by Owen (2010), has shown that computerized cognitive training leads to significant improvement in cognitive functions namely, reasoning, memory, planning, visuo-spatial skills and attention in 11,430 adult participants.

However, there has been a dearth of literature on the efficacy of computer based cognitive retraining in remediating developmental skill deficits such as reading, spelling and arithmetic and also, its effect when used in conjunction with education based remedial interventions. In the backdrop of this, the present study was undertaken to evaluate the efficacy of computer assisted cognitive retraining in the management of various specific learning disorders, when used in conjunction with education based remedial training.

II. RESEARCH ELABORATIONS

***Objective*:** The main aim of this research has been to test the effectiveness of Computer assisted cognitive training used as an adjunct to education based remedial training in improving the scholastic skills of children with specific learning disorders. It was hypothesized that children undergoing this combined intervention would perform significantly better than children undergoing only the education based remedial training in

domains of attention, reading, reading comprehension, spelling and arithmetic.

***Design*:** This study employed a between group before and after with control experimental design.

Sample: Subjects (N=10) between the ages of 8 and 15 years referred with academic difficulties to the outpatient clinic of the department of Clinical Psychology of Kasturba Hospital, Manipal were clinically screened for the possibility of any of the Specific Developmental Disorders of Scholastic Skills without any co-morbidity of behavioral and emotional disorders (except Disturbance of Activity and Attention (F90.0) under Hyperkinetic Disorder), according to ICD-10 criteria. Those suspected to be having either Specific Reading Disorder (F81.0), Specific Spelling Disorder (F81.1), Specific Disorder of Arithmetical Skills (F81.2) or combination of any of these scholastic skills were taken up for a detail psychometric assessment which consisted of assessment of intelligence, type(s), nature and severity of scholastic skill deficits. Following the assessment, those having intelligence quotient of above 70 and meeting the ICD-10 criteria for Specific reading disorder, Specific spelling disorder and Specific arithmetic disorder or combination of any of these were sequentially assigned to either of the following two remedial treatment groups:

1. RT+ group which received both Computer Assisted Cognitive training and Education based Remedial training.
2. RT- group which received only Education based Remedial training.

Inclusion criteria:

1. Age - 8 - 15 years (2nd to 10th standard)
2. Meeting ICD criteria for either Specific Reading Disorder (F81.0), Specific Spelling Disorder (F81.1) or Specific Disorder of Arithmetical Skills (F81.2), alone or in combination with or without Disturbance of Activity and Attention (F90.0)
3. IQ of 70 or above on Binet Kamat test of Intelligence

Exclusion criteria:

1. Specific Developmental Disorders of Scholastic Skills with comorbid disorders like seizure, conduct and emotional disorders.
2. Subjects expressing difficulty to attend at least 2 sessions/per week of training.

Measures used

Binet Kamat Test of Intelligence (Kamat, 1967): This test is an age scale employed widely for measuring general mental ability. This scale of intelligence comprises of 78 main test items and 21 alternate test items. The entire scale is graded and covers ages from 3 to 22 years. The test consist of items which include vocabulary, language development, comprehension, sentence building, similarities and differences, analogies, sentence repetition, auditory perception, social reasoning and visuo-motor co-ordination ability. Based on the Intelligence Quotient, it becomes possible to understand the child's cognitive ability.

NIMHANS Index of Specific Learning Disabilities (John, 1989): This battery was developed to identify children with specific learning disorders. The index comprises of the tests for Attention, Language (Reading, Writing, Spelling and Comprehension), Arithmetic (Addition, Subtraction, Multiplication, Division and Fractions), Visuo-motor skill (the Bender Gestalt Test and the Developmental Test of Visuo-Motor integration), Memory (Auditory and Visual).

III. REMEDIAL TRAINING

Computer Assisted Cognitive Training (CACT) : This training was carried out by using the software (vol. 1.3) obtained from Judith Falconer, Parker Co. (US) named as - **BRAIN TRAIN®**

It consists of an integrated set of 52 computer programs designed to assist in remediation of a wide range of cognitive and behavioral deficits commonly seen in individuals with brain injuries (through trauma, stroke, encephalopathy, aneurysm, etc.) or those who are developmentally disabled. For the purpose of this study, the remedial tasks were mainly targeted at attention, visuo-spatial ability, visual perception, working memory, visual discrimination, speed of information processing and visual memory.

Education Based Remedial training (EBRT): Children with reading, spelling and arithmetic difficulties were given many drill and practice exercises. They were taught grapheme-phoneme connections, use of sight words, flash cards and basic mathematical operations. SQ3R method was taught to some of the children. The remedial training was conducted depending on the educational needs of each child.

Procedure

Each group consisted of five children. Group 1 (RT+) received both EBRT and CACT while group 2 (RT-) received only EBRT. The interventions were carried out, on out-door basis, depending on the group for which a child was assigned. The CACT was carried out in a minimum of 15 sessions and a maximum of 20 sessions spread over a period of 3 – 5 weeks and education-based remedial training was carried out in a minimum of 8 sessions and a maximum of 12 sessions spread over 2 – 5 weeks. Duration of each of the sessions ranged between 60 – 90 min. In the RT+ group, the CACT and EBRT were carried out in parallel. Post-assessment was carried out employing NIMHANS SLD Index following completion of the intervention(s). The assessment scores in both the groups were analyzed using SPSS 16.0 to assess for significance level. The difference between the RT+ and RT- groups were analyzed using independent samples t test while the differences with regard to pre and post assessment scores of the RT+ group (group undergoing both EBRT and CACT) were analyzed using the paired samples t test.

IV. RESULTS

Table 1

Reflects the descriptives and independent sample t test results for both the RT+ and RT- groups on post assessment

Variables	Groups	M (±SD)	t value	Sig.
Attention (errors)	RT+	6.00 (±5.05)	1.10	0.31
	RT-	2.80 (±4.15)		
Reading (errors)	RT+	12.20 (±8)	0.94	0.38
	RT-	7.00 (±9.54)		
Reading comprehension	RT+	3.20 (±1.30)	0.00	1.00
	RT-	3.20 (±1.90)		
Spellings	RT+	10.20 (±2.59)	0.29	0.78
	RT-	9.60 (±3.91)		
Arithmetic	RT+	16.80 (±6.38)	0.07	0.94
	RT-	16.40 (±10.41)		

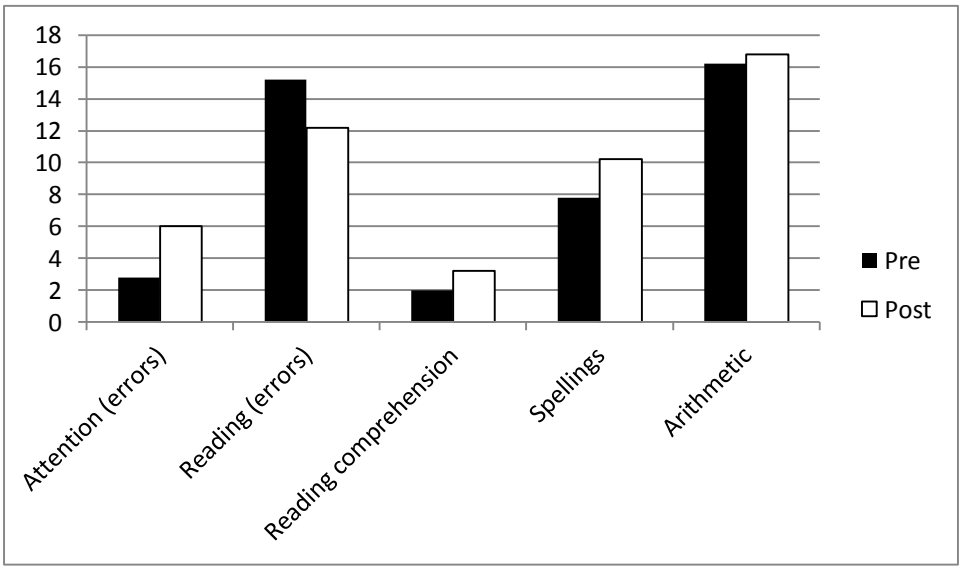
Table 2

Reflects the descriptives and paired sample t test results of the RT+ group

Variables	Assessments	M (±SD)	t value	Sig.
Attention (errors)	Pre-	2.80 (±4.20)	1.5	0.21
	Post-	6.00 (±5.05)		
Reading (errors)	Pre-	15.2 (±12.42)	0.31	0.78
	Post-	12.20 (±7.95)		
Reading comprehension	Pre-	2.00 (±1.88)	1.81	0.14
	Post-	3.20 (±1.30)		
Spellings	Pre-	7.8 (±2.59)	3.54	0.024
	Post-	10.2 (±2.59)		
Arithmetic	Pre-	16.2 (3.03)	0.30	0.78
	Post-	16.8 (6.38)		

Figure 1

Reflects the pre and post assessment changes on the cognitive and learning domains



V. CONCLUSIONS

The present study examined whether or not enhancing the neuro-cognitive functions through computer-based cognitive training produce additional benefits over and above that produced by the education-based remedial training in the management of SLD. The table 1 results indicated that skills in attention, reading, reading comprehension, spelling and arithmetic improved better in group given computer assisted cognitive training along with education based remedial training than in group given only education based remedial training. However, the differences observed between the groups were not statistically significant. The results of the present study provide a seminal evidence that the neuropsychological remediation of the

cognitive deficits such as attention, working memory, visuospatial ability, visual perception, visual discrimination, visual memory and speed of information processing through computer package contributes further to the improvement that are derived from the education-based remedial training.

Table 2 reflects that the combined intervention of CACT and EBRT, has not led to significant improvement in attention, reading, reading comprehension and arithmetic. A significant improvement is noted only in Spelling scores ($t = 3.54$; $p<0.05$). Overall, the means of the pre and post assessment scores of the RT+ group indicate that there has been an increase in the errors on attention. But there has been a reduction of reading errors. The RT+ group also appears to show some improvement (as reflected in figure 1) in performance on the Reading comprehension and Arithmetic domain; however these improvements are not significant presumably due to the small sample size of only 5 children.

However, the fidelity of CACT needs to be examined more closely in future studies, bearing in mind the issues raised below related to the present study,

Generally it has been observed that the CACT in the remedial training programs of various conditions are usually carried out over a period of 8 or more weeks with daily sessions lasting for 1 – 2 hours with several home assignments. For example, in a study by Ruff et al (1989) on head injury patients, the retraining was conducted over 8 week period, each patient receiving 160 hours of intervention in total. This study showed significant improvement in targeted cognitive functions in these patients. In the current study however, the number of hours of computer-based cognitive training was considerably less (average = 16 hours). In contrast, Owen's (2010) research which had led to significant findings, had used a large sample of 11, 430 participants on whom the cognitive training was conducted for a longer duration of 25 sessions.

Children with specific learning deficits have demonstrated neuropsychological deficits which however are more subtle compared to the deficits seen in people with severe conditions like head injuries, schizophrenia, etc. However, the efficacy studies of computer based cognitive retraining have been done on severely disabled conditions viz. traumatic brain injury patients on whom it is easier to observe improvement achieved by these interventions owing to severity of deficits. Hence improvement in subtle cognitive deficits in SLD group with this kind of training package requires longer duration of training. In the present study however, the training was carried out for a relatively shorter duration.

The absence of significant difference between the groups in current study could also be due to the ceiling effect. The performance of children with education-based remedial training might have produced the maximum beneficial effects, and adding or not-adding yet one more intervention might not have been of any consequence on the treatment outcome.

Further studies however, are needed to assess individual effects of Computer assisted cognitive training in the remedial training of scholastic skills, and its effects when used as adjunct in a much larger sample.

VI. EDUCATIONAL IMPLICATIONS

This research has important implications for teachers, special educators and cognitive rehabilitators in the remediation of children presenting with learning difficulties. Computerized cognitive training when used as an adjunct helps the child improve his foundation skills of attention, memory, processing speed, etc. along with academic skills and this combination of remediation would go a long way in sustaining the interest and motivation of the child to do well academically.

REFERENCES

[1] Harris, J. (1995). Developmental neuropsychiatry: assessment, diagnosis and treatment of developmental disorder. *In*: S. Bhasi. *Remediation for arithmetic disorder: A neuropsychological perspective.* Unpublished Thesis. NIMHANS.

[2] Mittal, S.K., Zaidi, I., Puri, N., Duggal, S., Rath, B. and Bhargava S. K., (1977). Communication disabilities: Emerging problems of childhood. *Indian journal of pediatrics*, 14, 811-815.

[3] Owen, A. M. (2010). Putting brain training to the test, *Nature*, 465, 775-778.

[4] Ramaa, S. and Gowramma, I.P. (2002). A systematic procedure for identifying and classifying children with dyscalculia among primary school children in India. *Dyslexia*, 8, 67-85.

[5] Richards, G. P., Samuels, J., Turnure, J.E. and Ysseldyke, J.E. (1990). Sustained and selective attention in children with learning disabilities. *Journal of learning disabilities*, 23, 129-136.

[6] Ruff, R.M., Baser, C.A., Johnston, J.W., Marshall, L.F., Klauber, S.K., Klauber, M.R., and Mintereer, M., (1989). Neuropsychological rehabilitation: An experimental study with head-injured patients. *Journal of head trauma rehabilitation*, 4(3), 20-36.

[7] Shah, B.P., Khanna, S.A., and Pinto, N. (1981). Detection of learning disabilities in school children. *Indian journal of pediatrics*, 48, 767-771.

[8] Shapiro, B. K. and Gallico, R. P. (1993). Learning disabilities. *Pediatric clinics of North America*, 40, 491-505.

[9] Swanson, H. L. and Siegel, L. (2001). Learning disability as a working memory deficit. *In*: B. Wong, ed. *Learning about learning disabilities*. New York: Academic Press.

[10] Wilson, A. M. and Lesaux, N. K. (2001). Persistence of phonological processing deficits in college students with dyslexia who have age-appropriate reading skills. *Journal of learning disabilities*, 34 (5), 394-400.

AUTHORS

First Author – Mrs. Nisha Vidyasagar, Ph.D. Scholar, Christ University, Bangalore. nishavidyasagar@hotmail.com
Second Author – Dr. K.B. Kumar, Professor and Head, Psychology, Sweekar Academy, Secunderabad.

Correspondence Author – Nisha Vidyasagar; nishavidyasagar@hotmail.com; +919900522994